

# PATENT COOPERATION TREATY

## PCT

### INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY


(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

REC'D 31 MAR 2006

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Applicant's or agent's file reference P27103PC00		<b>FOR FURTHER ACTION</b>		See Form PCT/PEA/416
International application No. PCT/IB2004/051459	International filing date (day/month/year) 13.08.2004	Priority date (day/month/year) 14.08.2003		
International Patent Classification (IPC) or national classification and IPC H01L31/032, H01L31/18, H01L21/00				
Applicant RAND AFRIKAANS UNIVERSITY ET AL.				
<p>1. This report is the International preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 5 sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <p>a. <input type="checkbox"/> sent to the applicant and to the International Bureau a total of sheets, as follows:</p> <p><input type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).</p> <p><input type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.</p> <p>b. <input type="checkbox"/> (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</p>				
<p>4. This report contains indications relating to the following items:</p> <p><input checked="" type="checkbox"/> Box No. I Basis of the opinion</p> <p><input type="checkbox"/> Box No. II Priority</p> <p><input type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</p> <p><input type="checkbox"/> Box No. IV Lack of unity of invention</p> <p><input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p><input type="checkbox"/> Box No. VI Certain documents cited</p> <p><input type="checkbox"/> Box No. VII Certain defects in the international application</p> <p><input checked="" type="checkbox"/> Box No. VIII Certain observations on the international application</p>				
Date of submission of the demand 04.10.2005		Date of completion of this report 22.12.2005		
Name and mailing address of the International preliminary examining authority:  European Patent Office - Glitschiner Str. 103 D-10958 Berlin Tel. +49 30 25901 - 0 Fax: +49 30 25901 - 840		Authorized Officer Voignier, V Telephone No. +49 30 25901-760		



**Re Item V**

**Reasoned statement with regard to novelty, inventive step or industrial applicability;  
citations and explanations supporting such statement**

1) Reference is made to the following document:

D1: OHASHI D ET AL: "Improved CIGS thin-film solar cells by surface sulfurization using  $\text{In}_2\text{S}_3$  and sulfur vapor" SOLAR ENERGY MATERIALS AND SOLAR CELLS, ELSEVIER SCIENCE PUBLISHERS, AMSTERDAM, NL, vol. 67, no. 1-4, March 2001 (2001-03), pages 261-265, XP004224769 ISSN: 0927-0248

D2: TURCU M. ET AL: "Composition dependance of defect energies and band alignments in the  $\text{Cu}(\text{In}_{(1-x)}\text{Ga}_x)(\text{Se}_{(1-y)}\text{S}_y)_2$  alloy system" JOURNAL OF APPLIED PHYSICS, vol. 91, no. 3, 1 February 2002 (2002-02-01), pages 1391-1399, XP002334413

2.1) The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of independent claim 1 is not new in the sense of Article 33(2) PCT. Document D1 (see D1, fig. 3, and section 3. "Results and Discussion") discloses a quaternary or pentenary alloy  $\text{Cu}(\text{In,Ga})(\text{Se,S})_2$  whose X ray diffraction patterns have a main [112] peak at a 2 theta angle of  $27^\circ$  for an incidence angle of the X-ray comprised between  $0.1^\circ$  and  $10^\circ$  (since the 2 theta angle has the same value,  $27^\circ$ , for an incidence of  $0.1^\circ$ ,  $1^\circ$  and  $10^\circ$  it is clear for the skilled person that the 2 theta angle is also  $27^\circ$  for the intermediate incidence angles), which is the subject-matter of claim 1. The subject-matter of claim 1 is therefore not new and this claim is not allowable under Art. 33(1) and (2) PCT.

2.2) The subject-matter of dependent claims 2-4, 6-12 and 33-37 is also disclosed by document D1, therefore these claims add nothing new to the subject-matter of claim 1 from which they depend.

3) The specific compositions of the alloy given in claims 5 and 13-32 are considered as standard for the skilled person (see for example document D2, fig. 2 and 6) and do not add anything inventive to the subject-matter of claim 1 from which they depend (Article 33(3)

PCT).

4) Furthermore, the above-mentioned lack of novelty notwithstanding, the application does not meet the requirements of Article 6 PCT, because claims 1, 6, 7, 9, 10, 17-20, 27-29 are not clear. The GIXRD pattern is not a physical property of the alloy itself, but the result of a characterisation measurement conducted on a film made of this alloy.

Such definition of the corresponding technical feature is unclear, rendering difficult a meaningful comparison of the technical features claimed with the available prior art, and are not allowable under Art. 6 PCT.

5) All the claim meet the PCT requirement in regard with industrial applicability.

**Re Item VIII**

**Certain observations on the international application**

The application does not meet the requirements of Article 6 PCT, because claims 1, 2, 6-12, 16-22, 26-31 and 37 are not clear.

These claims do not meet the requirements of Article 6 PCT in that the matter for which protection is sought is not clearly defined. The claims attempt to define the subject-matter in terms of a result to be achieved without providing the technical features necessary for achieving this result: the technical features of the alloy of the invention are given in terms of the GIXRD pattern, the variance in d-spacing, the range in which the bandgap can be shifted, or the efficiency of a solar cell using the alloy. Such definitions of the technical features are unclear, rendering difficult a meaningful comparison of the technical features claimed with the available prior art, and are not allowable under Art. 6 PCT.

**INTERNATIONAL PRELIMINARY REPORT  
ON PATENTABILITY**

International application No.  
PCT/IB2004/051459

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**Box No. I Basis of the report**

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1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
- ☐ This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:
- ☐ international search (under Rules 12.3 and 23.1(b))
  - ☐ publication of the international application (under Rule 12.4)
  - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)
2. With regard to the **elements\*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

**Description, Pages**

1-60 as originally filed

**Claims, Numbers**

1-37 as originally filed

**Drawings, Sheets**

1/28-28/28 as originally filed

- ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing
3. ☐ The amendments have resulted in the cancellation of:
- ☐ the description, pages
  - ☐ the claims, Nos.
  - ☐ the drawings, sheets/figs
  - ☐ the sequence listing (*specify*):
  - ☐ any table(s) related to sequence listing (*specify*):
4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
- ☐ the description, pages
  - ☐ the claims, Nos.
  - ☐ the drawings, sheets/figs
  - ☐ the sequence listing (*specify*):
  - ☐ any table(s) related to sequence listing (*specify*):

\* If item 4 applies, some or all of these sheets may be marked "superseded."

**INTERNATIONAL PRELIMINARY REPORT  
ON PATENTABILITY**

International application No.  
PCT/B2004/051459

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**Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

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1. Statement

Novelty (N)	Yes: Claims	5,13-32
	No: Claims	1-4,6-12,33-37
Inventive step (IS)	Yes: Claims	
	No: Claims	1-37
Industrial applicability (IA)	Yes: Claims	1-37
	No: Claims	

2. Citations and explanations (Rule 70.7):

**see separate sheet**

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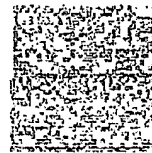
**Box No. VIII Certain observations on the international application**

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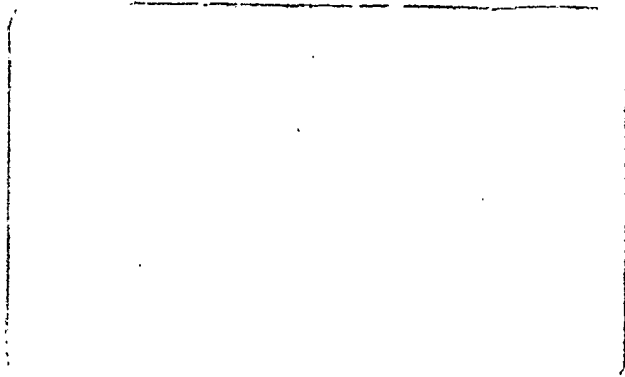
The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

**see separate sheet**

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REC'D 28 DEC 2005  
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28 DEC 2005  
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# PATENT COOPERATION TREATY

REC'D 25 JUL 2005

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From the  
INTERNATIONAL SEARCHING AUTHORITY

To:

see form PCT/ISA/220

07-13

PCT

## WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY (PCT Rule 43bis.1)

Date of mailing  
(day/month/year) see form PCT/ISA/210 (second sheet)

Applicant's or agent's file reference  
see form PCT/ISA/220

**FOR FURTHER ACTION**  
See paragraph 2 below

International application No.  
PCT/IB2004/051459

International filing date (day/month/year)  
13.08.2004

Priority date (day/month/year)  
14.08.2003

International Patent Classification (IPC) or both national classification and IPC  
H01L31/032, H01L31/18

Applicant  
RAND AFRIKAANS UNIVERSITY

### 1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☐ Box No. VIII Certain observations on the international application

### 2. FURTHER ACTION

If a demand for international preliminary examination is made, this opinion will usually be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA"). However, this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of three months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

### 3. For further details, see notes to Form PCT/ISA/220.

Name and mailing address of the ISA:



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**WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING AUTHORITY**

International application No.  
PCT/IB2004/051459

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**Box No. I Basis of the opinion**

---

1. With regard to the **language**, this opinion has been established on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.
  - ☐ This opinion has been established on the basis of a translation from the original language into the following language , which is the language of a translation furnished for the purposes of international search (under Rules 12.3 and 23.1(b)).
2. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application and necessary to the claimed invention, this opinion has been established on the basis of:
  - a. type of material:
    - ☐ a sequence listing
    - ☐ table(s) related to the sequence listing
  - b. format of material:
    - ☐ in written format
    - ☐ in computer readable form
  - c. time of filing/furnishing:
    - ☐ contained in the international application as filed.
    - ☐ filed together with the international application in computer readable form.
    - ☐ furnished subsequently to this Authority for the purposes of search.
3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.
4. Additional comments:



**WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING AUTHORITY**

International application No.  
PCT/IB2004/051459

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**Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

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1. Statement

Novelty (N)	Yes: Claims	
	No: Claims	1-37
Inventive step (IS)	Yes: Claims	
	No: Claims	1-37
Industrial applicability (IA)	Yes: Claims	1-37
	No: Claims	

2. Citations and explanations

**see separate sheet**

1) Reference is made to the following documents:

D1: OHASHI D ET AL: "Improved CIGS thin-film solar cells by surface sulfurization using  $\text{In}_2\text{S}_3$  and sulfur vapor" SOLAR ENERGY MATERIALS AND SOLAR CELLS, ELSEVIER SCIENCE PUBLISHERS, AMSTERDAM, NL, vol. 67, no. 1-4, March 2001 (2001-03), pages 261-265, XP004224769 ISSN: 0927-0248

D2: TURCU M. ET AL: "Composition dependance of defect energies and band alignments in the  $\text{Cu}(\text{In}_{(1-x)}\text{Ga}_x)(\text{Se}_{(1-y)}\text{S}_y)_2$  alloy system" JOURNAL OF APPLIED PHYSICS, vol. 91, no. 3, 1 February 2002 (2002-02-01), pages 1391-1399, XP002334413

2.1) The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of independent claim 1 is not new in the sense of Article 33(2) PCT.

Document D1 (see D1, fig. 1 and 3, and section 3. "Results and Discussion") discloses a pentenary alloy  $\text{Cu}(\text{In},\text{Ga})(\text{Se},\text{S})_2$  and a quaternary alloy  $\text{Cu}(\text{In},\text{Ga})\text{Se}_2$  whose X ray diffraction patterns have a main [112] peak at a 2 theta angle of respectively  $27.2^\circ$  and  $26.9^\circ$ , which is the subject-matter of claim 1.

The subject-matter of claim 1 is therefore not new and this claim is not allowable under Art. 33(1) and (2) PCT.

2.2) The subject-matter of independent claim 1 is also disclosed by document D2 (see D2, passages cited in the search report). Although the properties of the XRD pattern of the  $\text{Cu}(\text{In},\text{Ga})(\text{Se},\text{S})_2$  film of D2 are not specifically given, it is assumed that since the film is of the same composition as the film disclosed in D1, and has a similar crystallinity (polycrystalline), its XRD pattern will have the same properties.

Therefore the subject-matter of claim 1 is also not considered as not new in regard with document D2.

2.3) The subject-matter of dependent claims 1-23 and 33-37 is also disclosed by document D1, therefore these claims add nothing new to the subject-matter of claim 1

from which they depend.

Furthermore, the subject-matter of dependent claims 2-37 is disclosed by document D2, therefore these claims add nothing new to the subject-matter of claim 1 from which they depend.

3) Furthermore, the above-mentioned lack of novelty notwithstanding, the application does not meet the requirements of Article 6 PCT, because claims 1, 2, 6-12, 16-22, 26-31 and 37 are not clear.

These claims do not meet the requirements of Article 6 PCT in that the matter for which protection is sought is not clearly defined. The claims attempt to define the subject-matter in terms of a result to be achieved without providing the technical features necessary for achieving this result: the technical features of the alloy of the invention are given in terms of the XRD pattern, the variance in d-spacing, the range in which the bandgap can be shifted, or the efficiency of a solar cell using the alloy. Such definitions of the technical features are unclear, rendering difficult a meaningful comparison of the technical features claimed with the available prior art, and are not allowable under Art. 6 PCT.

4) All the claim meet the PCT requirement in regard with industrial applicability.